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| 09/976,624 | 10/12/2001 | Werner Juengling | MI22-1789 | 2304 |
| 21567 | 7590 | 10/24/2003 | EXAMINER | |
| WELLS ST. JOHN P.S. 601 W. FIRST AVENUE, SUITE 1300 SPOKANE, WA 99201 | | | KIELIN, ERIK J | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2813 | |

DATE MAILED: 10/24/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/976,624

Applicant(s)

JUENGLING ET AL.

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the corresponding address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 August 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 105,111-114 and 130 is/are pending in the application.
- 4a) Of the above claim(s) none is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 105,111-114 and 130 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

This action responds to the Amendments filed 16 July 2003 and 18 August 2003 (Paper nos. 14 and 16, respectively).

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims **105**, 112, 113, and 130 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,744,399 (**Rostoker et al.**) in view of US 4,843,034 (**Herndon et al.**).

Regarding claim 105, **Rostoker** discloses a method of forming a material adjacent a conductive electrical component or between a pair of conductive lines --as further limited by instant claim 113-- comprising:

providing the conductive electrical component **10** over a substrate **7** (col. 1, lines 28-30; col. 3, lines 6-12);

providing a initial material **20** (Fig. 2) having pores of a size (Fig. 1A; col. 2, lines 54-59) adjacent the conductive component **10**, wherein the initial material has a matrix forming material comprising silicon (SiO₂; col. 3, line 38-42) with fullerene (porous carbon molecules containing 32 to 960 carbon atoms; col. 3, lines 46-52) dispersed throughout, and where the initial material is applied by spinning on the matrix material with the fullerene dispersed therein (paragraph bridging cols. 4-5); and

vaporizing the portion into a initial material **24** (Fig. 4, col. 6, lines 41-47), wherein the vaporizing expands the size of the pores to form the insulative material (Figs. 1B-1D; col. col. 2, line 62 to col. 3, line 5), wherein the vaporizing is carried out using oxygen plasma or ozone (column 7, lines 20-49); and

forming a layer of an insulative material **40** overlying the initial material, after the vaporization step (column 6, lines 10-20, 40-45), as further limited by instant claim 112.

It is seen to be inherent that the dielectric constant of the initial material is decreased by vaporizing a portion of the initial material (i.e. the fullerenes) because the fullerene molecules are being decomposed and removed leaving behind space or air each of which has a lower dielectric constant than any solid material such as a fullerene molecule, which one of ordinary skill knows extremely well.

Rostoker does not indicate that the initial material may comprise molecules consisting of silicon and carbon. **Rostoker** does, however, indicate that the initial material may comprise a non-limiting list including silicon oxide, silicon nitride, aluminum oxide undoped silicon, and polyimide (col. 3, lines 28-43).

Herndon also teaches a method of forming an insulating initial material **I2** adjacent a conductive electrical component or between a pair of conductive lines **M1**, wherein the material may be silicon carbide, silicon nitride, silicon oxide, aluminum oxide, and polyimide (Fig. 2A; paragraph bridging cols. 3-4).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use silicon carbide as the matrix-forming, insulating initial material in **Rostoker** because **Rostoker** indicates that other insulating materials than those indicated above may be used for the

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matrix-forming initial material and because **Herndon** teaches an almost identical list of insulating materials for the same purpose of electrically insulating conductive lines on a semiconductor substrate, thereby indicating that silicon carbide is known, long before the invention of **Rostoker**, for the purpose of electrical insulation between conductive lines.

In this regard, note it has been held that the selection of a known material based on its suitability for its intended use is *prima facie* obvious. The selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) (Claims to a printing ink comprising a solvent having the vapor pressure characteristics of butyl carbitol so that the ink would not dry at room temperature but would dry quickly upon heating were held invalid over a reference teaching a printing ink made with a different solvent that was nonvolatile at room temperature but highly volatile when heated in view of an article which taught the desired boiling point and vapor pressure characteristics of a solvent for printing inks and a catalog teaching the boiling point and vapor pressure characteristics of butyl carbitol. "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.). See also *In re LESHIN*, 125 USPQ 416 (CCPA 1960) ("Mere selection of known plastics to make container-dispenser of a type made of plastics prior to the invention, the selection of the plastics being on the basis of suitability for the intended use, would be entirely obvious; and in view of 35 U.S.C. 103 it is a wonder that the point is even mentioned.") (See MPEP 2144.07.)

Regarding claim 130, silicon carbide is molecularly denoted as SiC_x.

3. Claim 111 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Rostoker** in view of **Herndon** as applied to claim 105 above, and further in view of US 5,494,858 (**Gnade et al.**).

Rostoker does not teach “forming a layer over the initial material **before** partially vaporizing” (emphasis added).

Gnade teaches a method of forming a porous dielectric layer **28** between conductive lines. **Gnade** also teaches that a layer 26 (Fig. 1C) may be formed before evaporating a portion of the initial material to increase the size of the pores (Fig. 1D).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to modify **Rostoker** in view of **Gnade** to partially vaporize after forming the layer over the initial material because it appears that forming the layer over the initial material before vaporizing would work just as well as forming it after vaporizing. Further the selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. (See MPEP 2144.04.) In the instant case, the same result is obtained in **Gnade** and **Rostoker**, i.e. a porous dielectric layer with a layer overlying the porous layer whether the layer is formed before or after the vaporization step. Moreover, the instant specification teaches away from any criticality to the order of steps since it is disclosed and claimed that the vaporizing of the initial material may occur either before or after forming “the layer” with equal results.

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4. Claim 114 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Rostoker** in view of **Herndon** as applied to claims 105 and 113 above, and further in view of either of **Matthews** (US 5,171,713) and **TeVelde** (US 4,561,173).

Rostoker does not teach support member between the pair of conductive metal lines.

Each of **Matthews** (US 5,171,713; Fig. 23B, 26B, pedestal **102** between conductive features **98** and **99**) and **TeVelde** (US 4,561,173; col. 5, lines 16-26; cover Fig., item **12** between conductive features **3-5, 10**) teach support structures used in air gaps to provide the needed support between metallization structures.

It would have been obvious for one of ordinary skill in the art, at the time of the invention to apply the support structures of either of **Matthews** and **TeVelde**, to the invention of **Rostoker**, to provide necessary support where support is needed, as between metallization structures, which are not close enough together to provide the needed support, as taught by **Matthew** and **TeVelde**.

Note in pertinent part that **Rostoker** indicates that the dielectric layer may be fragile and therefore in need of support due to the presence of overlying layers. (See also col. 5, lines 25-39.) One of ordinary skill would be motivated to use the support structures, additionally, because the dielectric in **Rostoker** could be made of even lower dielectric constant by incorporating even more pores. Such increase in pores, while lowering the dielectric constant, would also make the porous dielectric layer more fragile and consequently in need of such support members, but would also desirably result in reducing, further, the RC delay.

Should Applicant think that **Matthews** and **TeVelde** are not appropriate for the instant invention because of the method used to form the "support structures." Applicant is referred to

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the instant specification, page 14, lines 5-6, wherein it is stated, "Support members 38 can be formed by methods **readily apparent to persons of ordinary skill in the art.**" (Emphasis added.) Therefore, all that is required of the inventions of either of **Matthews** and **TeVeld** is that they suggest the use of such support structure.

Response to Arguments

5. Applicant's arguments filed 16 July 2003 have been fully considered but they are not persuasive.

Examiner acknowledges the comment by Applicant's Representative regarding MPEP 2143. Examiner is well aware of the conditions to make a proper rejection under 35 USC 103(a) and respectfully asserts that such has been properly done in the previous Office action filed 19 March 2003 (Paper No. 12) and presently, as above.

Applicant argues that Rostoker does not teach the newly added limitation, "decreasing the dielectric constant of the initial material to form the insulative material by vaporizing a portion of the initial material to expand the size of the pores." Examiner respectfully disagrees. As noted above in the rejection, Rosktoker specifically expands the size of the pores because the fullerene molecules are being decomposed and removed leaving behind space or air each of which has a lower dielectric constant than any solid material such as a fullerene molecule, which one of ordinary skill knows extremely well.

Applicant incorrectly argues that Examiner applied the conductive silicon carbide of Herndon as the insulating matrix forming material of Rostoker. Examiner did no such thing. Rather Applicant ignored the passage cited by examiner that silicon carbide is insulative.

Accordingly, Applicant's argument is wholly without merit for ignoring the teachings in Herndon as well as the applied case law.

Conclusion

6. This action is made non-final to give Applicant the opportunity to respond to the new ground of rejection.

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 5,858,871 (**Jeng**) discloses forming a porous dielectric 20 between conductive metal lines 14a, 14b, 14c and then vaporizing to expand the size of the pores (paragraph bridging cols. 7-80).

US 5,461,003 (**Havemann et al.**), US 5,488,015 (**Havemann et al.**), US 5,723,368 (**Cho et al.**), US 5,750,415 (**Gnade et al.**), US 6,319,852 B1 (**Smith et al.**) each teaches methods of forming porous masses between conductive lines wherein the mass comprises molecules comprising silicon and carbon.

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after

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the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Erik Kielin
Primary Examiner
October 23, 2003